# CLOUD EXPEDITE: A Novel Generic Business Model for Emerging Paradigm Shift in Cloud Computing

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**Abstract:** Cloud computing is an emerging area of research and development in the realm of computer sciences. It offers a lot of potential in providing cost effective and efficient services to the consumers on the web. However, some issues still persist with respect to security and reliability of cloud applications. This contribution discusses the generic business models in cloud computing paradigm. On the basis of this discussion we propose a business model which we term as "Cloud Expedite". Cloud Expedite is a modified generic model for cloud computing applications that ensures separation of concerns and better user satisfaction for consumers and developers. The focus of this model is to divide infrastructure layer into two layers: infrastructure layer and cloud vendor layer, to introduce more effective separation of concern. This approach will result into better services to stakeholders. The proposed model mainly relies on SaaS model for service level agreements but also supports PaaS and IaaS models. We also discuss the evaluation strategies and challenges faced by this model.
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## 1. Introduction

Cloud computing is a phenomenon of modern era, which could be termed as a "rage", "cliché", "lifestyle", whatever you name it. Despite this hype, the scope, potential or the definition of cloud computing lacks universal consensus. Keeping in view the immense potential, cloud computing paradigm has still not fully overcome the obstacles, it faces. Cloud computing is a technology that uses the internet and central remote servers to maintain data and applications while ensuring that users get desired service in a cost effective yet efficient manner. It allows consumers and businesses to use applications without installation and enabling them to access their personal files at any computer with internet connectivity. This technology allows for more efficient computing by centralizing storage, memory, processing and bandwidth. Major purpose of cloud computing is to provide scalable and cost effective on-demand computing services which meet quality demands in an efficient manner. This is made possible specifically through services provided on network which are accessible via easy means [1]. Cloud Computing has enabled organizations to shift their Information and Communications Technology (ICT) infrastructures [2] to third parties, thereby optimizing their business options and reducing operational scope. Cloud computing has enhanced the operational efficiency of the organizations, also several new businesses and service opportunities have opened to cater for the growing demand [1, 3, 4]. Additionally, cloud computing focuses on operational savings and green technology, which will be at the centre of attention in the near future. The enhanced usage of cloud computing will also result in significant savings for the organization in the form of less dependence of in-house professionals and infrastructure such as servers etc.

The two most well established definitions of cloud computing are forwarded by Wang and GuiyiWei. According to Wang [5], Cloud computing can be defined as "A computing Cloud is a set of network enabled services, providing scalable, QoS guaranteed, normally personalized, inexpensive computing platforms on demand, which could be accessed in a simple and pervasive way". According to GuiyiWei [6] "Cloud computing is a natural evolution for data and computation centers with automated systems management, workload balancing, and virtualization technologies".

Some of the biggest hurdles in cloud adoption mainly focus on consumers discomfort in the following areas: security of service and underlying data, service availability and reliability, service management to ensure service level agreements, ensuring control over access and policies, and the appropriate administration to facilitate flexible pricing structures [7,8]. In the words of Mell and Grance, [10] cloud computing essentially exhibits five characteristics namely on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service.

Aaron Weiss [17] established that all major technology firms have a long term interest in propagation and growth of cloud computing.

In cloud computing, definition of a suitable business model in the very early stages of development is quite essential. The business model determines the kind of service to be provided, protocols and tariffs to be charged. Business model determines the economic strategy and operational modes of any software application or service. Selecting appropriate business model becomes an even more critical decision when dealing with such an important yet fluid service as cloud. Business models adopted by various cloud computing application vary over the whole spectrum of services provided. This is mainly due to varied nature of services being offered by various cloud vendors. Key business models include Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) among others. In this chapter, we present a comprehensive overview of leading business models being deployed by cloud computing service providers and will try to suggest possible improvements. We also present an optimized business model to ensure enhanced quality of service and efficiency of business applications while reducing operational costs to make such applications easily accessible to larger mass of users. In the course of proposing this model, we also briefly illustrate significance of various service line agreements in effective implementation. We also describe potential implementation, assessment and evaluation methodologies for proposed model and possible challenges faced by it. However, in the beginning, we present a comprehensive overview of cloud computing as we see it today and then we shall shift our focus to cloud computing business models and further details.

## 2. Value Chain and Business Models in Cloud Computing

Value chains are instrumental in better defining the perspective and purpose of any application domain both for the users and providers. Value chain can help us identifying our own standing vis a vis the industry as well as the requirement posed by the users. The traditional linear value chain for IT services, extending from consulting, design, implementation and operation of solutions and IT infrastructures to maintenance of the application is changing as a result of cloud computing concepts. Figure 3 presents the emerging linear value chain for cloud computing applications comprising of different parts.

In consonance with the above presented value chain (Fig. 3), the need is to have an effective set of business models that cater to the elementary units such as IaaS, PaaS etc. A lot of work has been going on in the development of effective business models that meet the needs of cloud computing environment [15]. Generic cloud computing aspects, such as a low price and flexible contractual models are supplemented by other factors. However, the degrees of influence possessed by these factors differ depending on the particular link in the value chain. Relevant factors in SaaS business model for instance are best-of-breed support for the company processes that are mapped, the provider's economic reliability, integration and migration interfaces, references and flexible price models. In the case of Platform as a Service (PaaS) providers, the key aspects are size of the community entrusted with developing the technology in question, simplicity of service deployment and architecture frameworks that support automatic scaling.

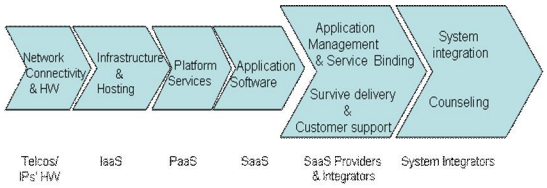


*Figure 1: Cloud Computing Linear Value Chain*

Similar classifications can be identified for other business models as well. This eco system, such as the one shown in figure 3, flourishes by providing easy-to-use basic IT services and middleware components as Web services. Such a system on the other hand also necessitates new stages in the value chain, such as service brokering and aggregation, trust and reputation assessments, service provision guarantees, minimum quality of service threshold etc.

In order to cater for various elementary elements of value chain given in figure 3, a generic model can be visualized as the one given in figure 4. As shown here, the model comprises of three main layers. The first layer deals with infrastructure which is solely the responsibility of cloud service providers. Service providers acquire service from developers and lease it out to users. They also work as service brokers. This layer includes tasks such as allocation of physical resources, network handling and virtualization. Second layer is concerned with developers of cloud applications where development of product platforms, service integration facilities and hardware related services are provided. At this level, new and more dynamic application development takes place according to the business needs of users. At third layer, we have customer who is involved in tasks such as consulting or seeking customer support etc. The visualized model is the main generic

business model being used by various cloud vendors all over the world mainly due to its easy understanding and relatively clear separation of concerns.

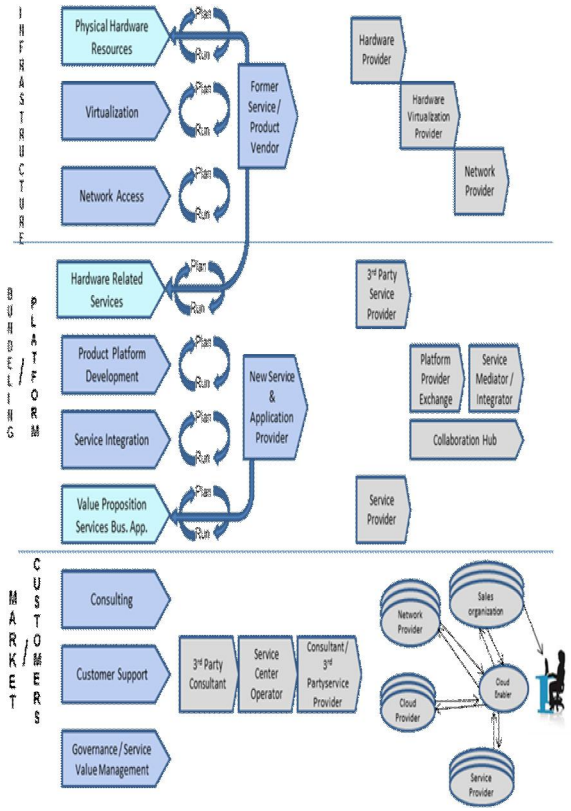


*Figure 2: Generic Cloud Computing Business Model*

However, the same generic business model as shown above is facing problems in yielding effective cloud application due to the fact that it ignores several key factors essential to establish better bonding between infrastructure and customer layer. Factors such as minimum quality of service threshold, trust and reputation assessments, service provision guarantees are not being handled in this model. In the last sections of this chapter, we shall propose a new business model for cloud computing applications which caters for these factors as well.

Based on this generic model that we have visualized above in figure 4, three dominant cloud computing business models were developed. All these models catered to varied needs of consumers. The were named as IaaS, PaaS and SaaS. The interaction between these models is shown in figure 5.

Software as a Service (SaaS) model is also referred as "Service on Demand" model. It is a lower-cost way for businesses to use software as needed rather than license every application on every device. There are business model variants based on pure SaaS solutions, with independent architectures. These include pay per use model, monthly service subscription model etc. A brief summary of SaaS features is provided by Pijanowski [9] in table 1. The advantages of SaaS model are cost effectiveness, faster Implementation, budget focus on competitive advantage, periodic subscription instead of upfront cost, multi-Tenant efficiency, flexibility, scalability and reliability. However, the model is particularly criticized for the fact that it doesn't allow user the option of customization of application on its own end. This means also that users can not control their computing in their own manner. The model is also criticized due to its perceived security risks.

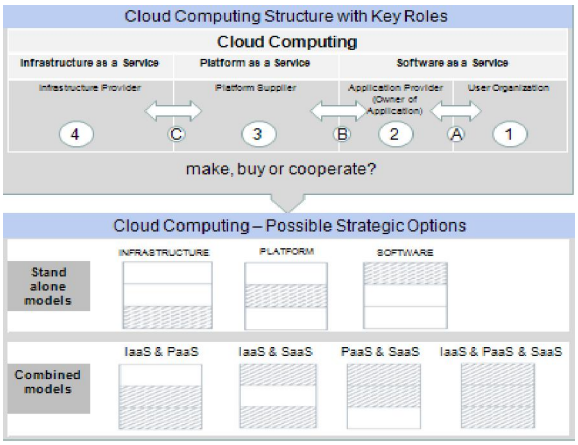


*Figure 3: Cloud Computing Specific Business Models*

In the case of Platform as a Service (PaaS) the business model variants are based on the service development stages of software provisioning, software delivery platform and full scope Platform as a Service. A brief summary of PaaS features is provided by Pijanowski [9] in table 2. This business model relates mainly to first and second layer of generic cloud computing business model. Using this model, provision of software to vendors is made effective between developers and vendors. In this model, instead of developing product in one environment and then hosting it in another, the entire software lifecycle is supported on the same computing environment. This helps in cutting of the development cost to a great extent since developers don't need to worry about issues such as platform migration, infrastructure non compatibility etc. The advantages of this business model include integrated development and deployment environment, optimal vendor satisfaction, built in scalability, security and collaboration support.

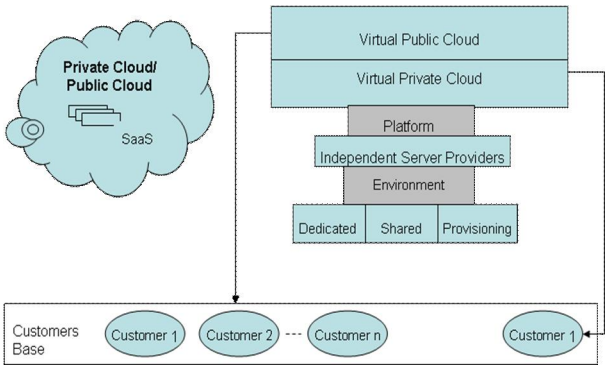


*Figure 4: Hosting model for Cloud Applications*

This model, despite being quite novel and interesting is also facing problems. It is quite difficult for developers to keep on working with customized products so the cost of development goes up. Most of the vendors after initial excitement are hesitant to pay such costs. In such a case, the development model collapses. As a result controlling mechanisms are incorporated to make it binding upon both the partners to work in a better environment.

Infrastructure as a Service (IaaS) business model comprised of three different types: public, private and hybrid cloud models. Hybrid cloud models enable a choice between on-premise solutions, solutions managed by a partner or solutions hosted by a third party. This model comes into play when some third party vendor uses the infrastructure of some other business to provide cloud services to its customers. As the next generation Internet blossoms, more organizations and individuals seek to share their hardware with others. Instead of developing individual infrastructure for every new cloud application being developed, IaaS provides a mechanism to share infrastructure resources among various vendors. In this way, we can say that this model is related to first layer of generic cloud computing business model. A common feature of all IaaS models is virtualization of infrastructure services and so a sharp reduction in the cost of procuring these services. For their part, infrastructure service providers are making huge investments in expanding large, virtualized server forms. A vital prerequisite is a high degree of automation in providing virtualized infrastructure services (dynamic services). It is also conceivable for bundling containing additional IT services to be offered on the market in addition to pure infrastructure offerings. The additional IT services include middleware components, in each case with or without a license for them being provided. One aspect that must be especially emphasized is the programmability of infrastructure services. In table 3, Pijanowski [9] has presented a summary of IaaS framework.

This model is particularly exciting for start up or small to medium level cloud vendors. The private cloud solution is highly expensive and is suitable only to larger than medium-sized companies and groups. It is generally (though falsely) assumed that security or service trust are features which only concern large scale service providers. In our opinion, in the environment of cloud applications, these factors are critical for every cloud vendor. So a need for a new business model becomes evident in this case. Currently, private cloud solutions have the advantages which public cloud solutions are apparently lacking – elasticity, dynamic provisioning, multiplexing etc. We perceive a new business model which ensures that public cloud solutions also provide such advantages to vendors using their infrastructure. The existing hosting model for cloud applications is shown in figure 6.

In the next sections, we summarize the current capabilities of SaaS, PaaS and IaaS. After that, we discuss an enhanced generic cloud computing business model.

Apart from these three main business models for cloud computing, several other classifications have emerged. Some researchers [11, 12, 13, 14] have classified these models based on (1) Service Provider and Service Orientation; (2) Support and Services Contracts; (3) In-House Private Clouds; (4) All-In-One Enterprise Cloud; (5) One-Stop Resources and Services; (6) Government funding; (7) Venture capitals and (8) Entertainment and Social Networking. However, as their names suggest, this classification is more of an extension of fundamental three business models as described earlier than a new classification.

## 3. Cloud Expedite: A Generic Cloud Computing Model

In the previous section, we discussed existing business models. From this discussion, certain things come to light which are:

- Cloud application users are interacting with vendors through SaaS model which deals with first and second layer of generic cloud computing model. However, issues of customization and security still persist which need to be resolved.
- Cloud computation developers and vendors are interacting through PaaS model which allows development of product at the vendor infrastructure thus allowing developers to focus on development rather than deployment. However cost issues force the developers and vendors to backtrack on their commitments quite often.
- Vendors use either public infrastructure or maintain their own private infrastructure. In case of public infrastructure, the vendors and infrastructure

providers interact with each other through IaaS model. Such arrangements lack certain important elements of cloud phenomenon such as elasticity and dynamism and also make security questionable.

- Certain hybridized models based on these basic models have also appeared as shown in figure 4. However, the problems mentioned above still persist. Two major factors contributing towards these problems are:
- In the generic business model of cloud computing applications, no provision has been made to ensure that end users receive best agreed quality at all the times. Similarly no specific guarantee has been provided that interests of developers and vendors will be safeguarded in case of dispute. In our opinion, it is extremely vital to incorporate features such as service brokering and aggregation, trust and reputation assessments, service provision guarantees, minimum quality of service threshold etc.
- The model being used today makes no distinction between cloud application vendors and infrastructure providers. With mushrooming of small to medium scale cloud application providers, private infrastructures will lose their relevance over the time if public infrastructure providers ensure elasticity, dynamism and security for their client vendors. A specific distinction between infrastructure providers and cloud vendors.

Keeping these findings in mind, we propose a new generic model for cloud computing applications. This model is named as "Cloud Expedite", which envisions clear separation of concerns between cloud infrastructure providers and cloud application vendors. As such, a new layer has been introduced in the model presented in figure 4 namely cloud vendors. The proposed model is shown in figure 7. The proposed model is based on SaaS business model. Reasons for the proposed model to be SaaS specific will be mentioned in later sections. The proposed model suggests an additional inclusion, explicit inclusion standards and protocols at the level of developers, infrastructure providers and cloud vendors.

Cloud Expedite ensures that trust, security and service protocols are agreed upon beforehand between developers, vendors, infrastructure providers and customers. This ensures a smooth service provision at all times which is mutually agreed upon. This new model also ensures that cloud vendors get a fair deal from infrastructure providers who invest in innovation and evolution to provide dynamism, elasticity and security to the client vendors. This will help in two distinct stakeholders focusing solely on their area of merchandise and its improvement.

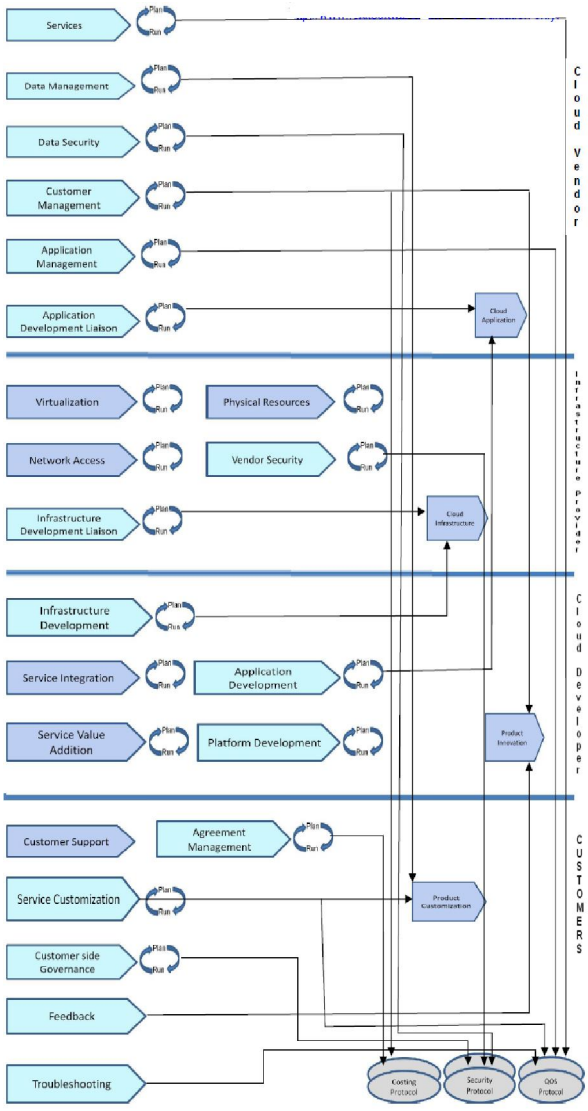


*Figure 5: CLOUD EXPEDITE; The proposed generic cloud computing model*

Developers will also be clear about their responsibilities whether to upgrade the infrastructure or develop a cloud application since both the layers are clearly separated. The long term interest of both developers and their clients will also be safeguarded when specific protocols regarding such matters will be enforced.

Users will have more and more freedom of choice since now they will be able to choose the infrastructure and cloud of their choice either as a package or as separate entities. The interests of users with respect to quality of service and its provision will also be safeguarded against the service providers and vice versa.

On the whole this new model will not only ensure smooth operations across the whole spectrum

of cloud environment but will also spur a new level of innovation as more and more resources will be directed towards right purposed. This wise investment will help in developing infrastructure in a better way on one hand and developing more and more efficient applications on the other.

The proposed model is a tentative model with room for improvement. We shall encourage further scholarly discussion on this model so that it can be improved and made more useful for the overall cloud computing community.

## 4. SaaS as Business Model for Cloud Expedite

Potential of emerging cloud computing business models and their competitive advantage over licensed software has been debated quite widely in the recent past [24, 25, 26]. Most of these studies [18, 19, 20] agree to the fact that most appropriate business model for cloud computing in user-driven environment of today's market is SaaS model. Software as a Service (SaaS) architecture has been regarded as leading business model for cloud computing since the dawn of 21st century. In one of his memos, Bill Gates proclaimed that the Software-As-A-Service (SaaS) business model will be the catalyst for "next sea-change" in computing [18].

Even in 2005, according to a research [19], SaaS market was growing at rate of 20% per annum. According to another research [23] at the same time, the same projection was at staggering 50%. Some of the benefits using SaaS model for an organization according to a study by University of California [20] include; predictable costs, increased bargaining power, ability to switch across providers and up to date software as the key benefits based on a one year experiment. V. Choudhary [21] and M. Dan [22] have extensively worked on understanding the implications of using SaaS as an underlying business model for cloud computing applications. V. Choudhary in his work has shown that user's experience using licensed products experiences a linear curve over time whereas products developed according to SaaS principles follow a constant pattern (see figure 8).

In his work [22], M. Dan made two propositions (1) with the passage of time as the "unfit" or transition costs reduce for the users, "the relative economic advantage of the SaaS business model increases monotonically" and (2) There is a non-monotonic relationship between user's exiting costs and SaaS vendor's profit. If it becomes economically unbearable for user to exit from vendor's application, it also becomes potentially dangerous for the vendor as it starts "scaring" way the potential clients.

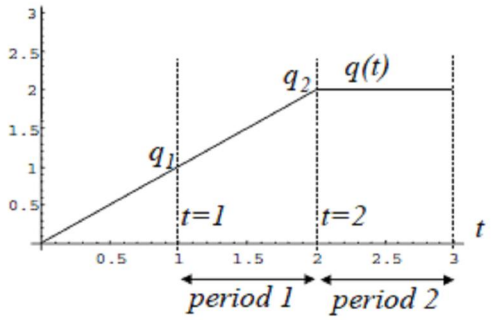


*Figure 6: Product quality over time. Under perpetual licensing users experience q1 and q2, whereas under SaaS, users experience q(t).*

All the above mentioned information suggests usability of SaaS model not just as an attractive option for innovation and efficiency but also as a scheme having in-built mechanisms to ensure both users and vendors interests are properly safeguarded. The recent studies (some of those also mentioned in our background studies) point to the fact that the single most encouraging factor for growth of innovation in 21st century is security and reliability. Using CLOUD EXPEDITE and basing it on SaaS model ensures that we provide users and vendors with both of these options.

Moreover, wide applicability of SaaS model, its relative maturity and easy to use established and standard procedures also make it an attractive choice for our proposed model. However, this doesn't mean that the proposed model only relies on SaaS model. Having such reliance will drastically reduce its control and impact on other two vital stakeholders i.e. infrastructure provider and developer. In order to make the proposed model effective and attain its full potential, it is proposed to incorporate relevant Service Level Agreements from Product as a Service (PaaS) and Infrastructure as a Service (IaaS) business models as well. In this way, interests of all concerned stakeholders can be safeguarded.

As figure 8 shows, with more and more reliability and trust injected into the applications, the overall qualitative impact of the products will enhance. The SaaS model already demonstrates higher qualitative impact. Based on SaaS model, the proposed model is also expected to yield better quality products.

## 5. Application and Challenges for Cloud Expedite

As discussed earlier, cloud computing represents a computing style in which dynamically scalable and often virtualized resources are offered as services over the Internet. This result in better service delivery more customized solutions and enhanced customer satisfaction. However, unfortunately,

despite introduction of cloud computing for about two decades now, the reality is that even today, most of the corporate software is based on firmly incorporated IT components within the enterprise IT infrastructure, which is controlled on a high level. The proposed generic business model envisions that even these traditionally controlled information systems can be transformed into network-based information systems, hosted in a dynamic environment ready to respond to the ever-changing needs of the customers. The major problems faced by traditional cloud computing models were the absence of responsibility and confidence in continuity of service in the face of any eventuality. The proposed CLOUD EXPEDITE model, attempts to overcome this problem by proposing a model in which vendor, infrastructure provider, developer and end user are bound by agreement to deliver a minimum set of quantifiable deliverables to each other. This concept offers a relatively loose yet binding relation between the customer and the service provider, to which the clients are getting more and more used to. With this kind of confidence in place, clients/end users can be more and more willing to shed their obscure and expensive infrastructure in favor of a dynamic one offered by cloud services provider. Such an arrangement not only ensures an efficient QOS compliant service to the client but also encourages innovation at the level of infrastructure provider and developer. Thus CLOUD EXPEDITE business model emerges as a guarantee to interests of all stakeholders involved.

However, the proposed model is not without its challenges. The foremost challenge is determination of its viability in actual industrial settings. The model has merely been proposed in this chapter and its actual implementation has yet to be seen. The focus of the research proposed in this chapter remains in proposing the underlying concept of transferring the business processes from their existing IT infrastructures, into the cloud-environment in a more secure, safe and efficient manner. The main purpose of this research is to propose such a generic business model that safeguards the interests of all stakeholders thereby encouraging more detailed design and implementation and standardization based on CLOUD EXPEDITE model. One potential area of implementation can be interconnection of semantic web services into cloud oriented infrastructure. Such an arrangement has already been proposed [16] and is in place as various service providers are using this phenomenon. The business model for any of these services can be transferred to the proposed one and results can be gauged in future quite easily. For the purpose of evaluation, another two approaches can be used in practical support of this theoretical proposal. First, a proper simulator can be designed and implemented in future to determine its applicability. This simulator can give a clear picture regarding minimum quality of service achieved, minimum user satisfaction, degree of innovation, evolution etc. Secondly, a prototype cloud application can be created using merely the basic tenants of proposed model without going into too much detail. Using one of the existing cloud platforms, this prototype could be deployed in a cloud environment in order to do performance analysis and to determine the functionalities, capabilities and performance of the semantic-service-oriented architecture lying behind what is known to the end customer as a cloud. Eventually, performed tests can lead to further improvement of the developed simulator which could be used as a software tool, useful in building semantic cloud infrastructures.

Second challenge is its perceived inclination towards client instead of vendor or developer. This challenge is not unique to this model only but has been faced by other cloud computing business models in the past as well. While it is clearly a better model for the consumer of the software, one can debate whether it's a better model for the software company. Using any of the cloud computing models including proposed one, the vendors or developers, instead of selling licenses of their products from the environs of their offices are forced to funnel capital again in sales and marketing departments. The service providers on the cloud using proposed models will have to scour for customers in a competitive environment. Otherwise, the customer will be picked by the rival providers. The challenge will make cloud computing a slightly tough option to swallow for the companies. However, this is a challenge which brings new opportunities with itself. New startups and innovative ventures will be the ones to benefit most from CLOUD EXPEDITE as their dynamism and energy will be critical in offering solutions which are exciting yet secure. A new age of exciting opportunities can be dreamed if such a scenario unfolds.

**Conclusion and Future Work**

In this chapter, we have discussed the generic business model of cloud computing in detail. We have thoroughly investigated the existing specific cloud computing models such as IaaS, SaaS and PaaS business models discussing their potential strengths and limitations. In order to overcome these limitations, we have proposed a new generic business model for cloud computing called "cloud expedite". This model envisages separation of infrastructure layer into two separate layers called "infrastructure layer" and "cloud vendor layer" to ensure better

separation of concerns in the environment of public infrastructure providers. We have also suggested inclusion of specific standards and protocols to ensure better delivery of services to all stakeholders. We have asserted that proposed model will be based mainly on SaaS model as far as service line agreements are concerned but at the same time will also incorporate relevant SLAs from PaaS as well as IaaS model. We have also briefly charted out the path towards assessment and evaluation of proposed model and at the same times outlines few challenges faced by it.

In future, we encourage thorough academic discussion and application of the proposed model to improve the services being offered on the cloud. We also suggest initiating work on distributing the responsibilities on infrastructure layer between central infrastructure location and intermediate network locations to offer services and monitor their quality at localized positions. We envisage a future business model which independently distributes cloud functionalities between user level, network level and vendor level.

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